<u>Remarks</u>

Allowance of all claims is respectfully requested. Claims 1-10 and 12-38 remain pending.

Initially, applicants thank the Examiner for the detailed comments provided in the Office Action mailed March 25, 2002, particularly at pages 2-6 thereof. Further, applicants again gratefully acknowledge allowance of claims 6, 8, 10, 14, 19, 27, 29 & 30. The Remarks which follow are directed to the remaining claims, and principally to independent claims 1, 17, 24, 31, 37 & 38.

In the final Office Action of March 25, 2002, claims 1-5, 7, 9, 12, 13, 15-18, 20-26, 28 & 31-38 were rejected under 35 U.S.C. 103(a) as being unpatentable over Uz (U.S. Patent No. 5,682,204) and Flannaghan (U.S. Patent No. 4,703,358). This rejection is respectfully traversed, and reconsideration thereof is requested for the reasons set forth below.

The present invention addresses in one aspect the problem of encoding an image containing both a <u>random noise portion</u> <u>and</u> a <u>normal video portion</u>. These portions comprise areas of significantly contrasted complexity. The invention enhances picture quality by dynamically adjusting the encoding of highly complex macroblocks (i.e., macroblocks comprising random noise) to use less bits, which in turn prevents over production of bits before the encoder reaches the bottom of the picture. This invention essentially <u>directs encoding bits from the random noise macroblocks to the simpler, normal video macroblocks</u>. Less bits are used

in the highly active and fine detail area, and thereby a more constant picture quality is ultimately obtained.

Applicants disclose a process for determining whether a given frame includes a random noise portion and a normal video portion. This process uses intraframe statistics to determine <u>without reference to another frame</u> whether the frame includes both a random noise portion and a normal video portion. Upon determining that these portions exist, applicants recite adjusting encoding of a macroblock within the random noise portion to reduce bits used in encoding that macroblock. This adjusting is accomplished by biasing the encoding thereof towards predictive coding, and thus, away from intra-coding of the macroblock which would be a conventional approach when complexity is detected within the macroblock.

With reference to the rejection, applicants respectfully submit that a valid obviousness rejection requires that the prior art patents, when combined, teach or suggest all of the claim elements. In the instant application, there are numerous features of applicants' claims which are not taught or suggested by the Uz and Flannaghan patents, either individually or in combination.

Initially, applicants note that no applied patent is directed to solving the problem identified by the present application. Specifically, applicants disclose a technique <u>for identifying a frame having random noise and normal video</u> portions. Once a frame is identified as having both a random noise portion and a normal video portion, then applicants dynamically adapt encoding of certain macroblocks in a specific manner. For example, encoding of a macroblock

falling within an identified random noise portion of the frame is adjusted so as to bias the coding of the macroblock towards being predictive coded. This biasing ensures that less bits are used in the random noise area of the frame which can then be used in the simpler, normal video macroblocks, thereby providing a more constant picture quality.

Uz describes a rate control algorithm for an MPEG-2 compliant encoder. See abstract. The rate control algorithm has embodiments useful for constant bitrate and variable bit rate encoding. In particular, the Uz invention relates to a quantization based, activity based, inter/intra decision.

A careful reading of Uz fails to uncover any teaching, suggestion or implication of the problem addressed by the present invention. Uz addresses encoding a sequence of frames for constant bit rate or for variable bit rate. Further, Uz notes that the MPEG-2 specification allows a frame to be encoded as a frame picture or the two fields to be encoded as two field pictures. Frame encoding or field encoding can be adaptively selected on a frame-by-frame basis. Frame encoding is typically preferred when the video scene contains significant detail with limited motion. Field encoding, in which the second field can be predicted from the first, is noted to work better when there is fast movement. See column 3, lines 20-29.

While Uz is directed to a rate control algorithm for encoding a sequence of frames for either constant bit rate or variable bit rate, a careful reading thereof fails to uncover any teaching, suggestion or implication of the

problem addressed by the present invention. Again, the current invention addresses encoding a frame <u>containing both a random noise portion and a normal video portion</u>, meaning that the frame necessarily contains areas of significantly contrasted complexity.

Further, applicants note that Uz suggests the use of "frame encoding" when "the video scene contains significant detail with limited motion". Column 3, lines 25-27. According to Uz, in encoding a frame containing a noisy portion (i.e., a portion with fast movement) field encoding is preferred. For field prediction data, one or more previous fields or previous and subsequent fields is needed. Column 3, lines 30-33. (Applicants note that the Examiner is interchanging what frame encoding and intra-frame encoding mean. Frame encoding is discussed in Uz at column 3, lines 25-28, which is distinct from intra-frame encoding.)

More particularly, frame coding refers to coding all the pixel lines within a single frame in a progressive format. Thus, the horizontal pixel lines coded are 1, 2, 3, 4.... Intra-frame coding refers to not using temporal redundancy to lessen the amount of data needed to code a frame. That is, all information used to code a frame is contained within the frame. No motion estimation or compensation is utilized. Intra-coding is used for certain macroblocks depending on coded picture type, and is present in either field or frame coded pictures.

In accordance with the present invention, a frame having both a random noise portion and a normal video portion does not affect the bit budget determined for that

picture by other means, or whether the picture is to be frame or field encoded. What it does affect are some of the decisions used to determine how to encode a macroblock within the random noise portion of the picture. These decisions are biased in certain directions based on the predetermination that both a random noise portion and a normal video portion are present within the picture.

The current invention adjusts the encoding of a single frame based on the difference in activity levels of the macroblocks comprising the single frame. The current invention preserves more bits for the less noisy area (i.e., normal video portion) of an image at the expense of the highly complex image area (i.e., random noise portion) of the frame. Uz makes no similar adjustment (nor does Flannaghan).

This adjustment is particularly recited in each of the independent claims. Specifically, the independent claims specify adjusting encoding of a macroblock when its activity level exceeds a predefined threshold indicative of the macroblock being associated with a random noise portion of a frame. The adjusting is accomplished by biased encoding of that macroblock towards predictive coding, and thus, away from intra-coding. This save bits which would otherwise be used to encode the macroblock as an intra-coded macroblock, and provides a more constant picture quality as a result of the encoding process. Again, Uz makes no similar adjustment to that recited by applicant.

While both Uz and the present invention calculate values for macroblocks, the two inventions implement these calculations in distinct manners. To calculate the activity

in masking activity levels, Uz uses not only the blocks comprising the current macroblock, but also the eight blocks that surround the current macroblock. Column 9, lines 20-21. In contrast, the current invention uses <u>only</u> information within the current macroblock in obtaining values for that macroblock. Therefore, applicants respectfully submit that these calculations are fundamentally different.

As recognized in prior Office Actions, a careful reading of Uz does not disclose any mention of applicants' concept of determining whether a frame includes a noisy portion, let alone both a <u>random noise portion</u> and a normal video portion. For a teaching of this concept, the Office Action also references Flannaghan (in particular, column 3, lines 3-10 of Flannaghan). This characterization of Flannaghan and its applicability to the amended claims presented herewith is respectfully traversed.

Flannaghan describes an apparatus for processing a television signal including a movement detector. The detector evaluates an absolute frame difference signal on a sample by sample basis and removes unwanted noise. In the process described by Flannaghan, a frame difference which is greater than the coring threshold but surrounded by frame differences below the threshold is assumed to be noise and thus ignored. Column 3, lines 11-14. Thus, in accordance with the noise reduction scheme of Flannaghan, noise is reduced in a series of frames by essentially changing the input data, i.e., by modifying the noisy data (e.g., pixels).

There are significant differences between applicants' claimed invention and the teachings of Flannaghan. For example, applicants recite a technique for dynamically adapting encoding of a frame having a random noise portion and a normal video portion. Advantageously, processing in accordance with the present invention prevents noisy macroblocks or blocks with random details from consuming all or most of the picture bits, which in turn prevents overproduction of bits before the encoder reaches the bottom of a given picture. The present invention essentially directs encode bits from the random noise macroblocks to the simpler, normal macroblocks. Less bits are used in the highly active and fine detail area, thereby providing a more constant picture quality. This is recited in the independent claims presented herewith as adapting the encoding of a macroblock within a random noise portion of a frame so as to bias the encoding thereof towards predictive coding (and thus away from intra-coding).

Applicants note that Flannaghan (as with Uz) does not address or discuss the same problem as that to which the present invention is directed. Flannaghan describes a noise reduction scheme which removes injected noise from a picture by changing the input data. A careful reading of Flannaghan fails to uncover any discussion directed to a dynamic encode approach which prevents random noise macroblocks or blocks with random details within a frame from consuming all or most of the picture bits for that frame. For this reason, applicants respectfully submit that one of ordinary skill in the art would not have combined the teachings of Flannaghan and Uz to arrive at a dynamic encode approach as recited in the independent claims presented herewith.

Further, a careful reading of Flannaghan fails to uncover any teaching, suggestion or implication that intraframe statistics can be employed alone, without reference to another frame, to determine whether the given frame includes a random noise portion and a normal video portion. Noise is defined in Flannaghan as a difference of signal A with a signal from a previous frame (see column 2, lines 42-45). For this additional reason, applicants respectfully submit that the Office Action combination of Uz and Flannaghan fails to teach or suggest all of the claimed elements. Thus, applicants respectfully request reconsideration and withdrawal of the obviousness rejection to the independent claims based upon the teachings thereof.

To summarize, applicants respectfully submit that their invention as recited in the independent claims presented herewith would not have been obvious to one of ordinary skill in the art based on the teachings of Uz and Flannaghan. Neither patent addresses or discusses the same problem as that to which the present invention is directed. Although applicants recognize that Uz describes an adaptive encoding approach, the problem addressed therein, how the adaptation occurs, as well as the specific adaptation are different from that of the adaptive encoding approach of the present invention. The current invention addresses encoding an image containing both a random noise portion and a normal video portion.

The secondary citation to Flannaghan teaches a noise detection and noise removal technique. Noise is defined as the difference of signal A with a signal from a previous frame. Flannaghan teaches a scheme to remove noise in a picture by changing the input data. In contrast, applicants

recite using intra-frame statistics to determine without reference to another frame whether a current frame includes a random noise portion and a normal video portion, and if so, applicants recite dynamically adjusting encoding of one or more macroblocks within that frame by biasing the coding thereof towards predictive coding. In applicants' approach, the random noise portion of the frame is encoded as is without any alteration of the data. This is contrasted with Flannaghan which expressly teaches alteration of the data.

For all the above reasons, applicants respectfully submit that the independent claims presented herewith patentably distinguish over Uz and Flannaghan, both individually and in combination.

Applicants again thank the Examiner for the detailed remarks provided at pages 2-6 of the final Office Action. Applicants reply to certain of these remarks as follows.

Applicants initially recite a process for determining whether a frame includes a <u>random noise portion</u> and a normal video portion. Uz does not make such a determination. In his remarks, the Examiner appears to indicate that because Uz describes a scene containing "significant detail" this necessarily means or <u>implies</u> that the frame contains random noise. Applicants respectfully submit that this mischaracterizes the teachings of Uz and is a result of hindsight application of the present teachings to the Uz patent. A careful reading of Uz fails to uncover any suggestion or implication that the "significant detail" discussed in Uz actually comprises a frame having a random noise portion and a normal video portion. Absent this

teaching, applicants respectfully submit that there is no suggestion of their claimed invention in Uz.

Further, applicants recite in the independent claims that this determination is made using intra-frame statistics without reference to another frame. This language clearly distinguishes applicants' approach over any implication derivable from the teachings of Flannaghan. As noted above, Flannaghan describes the elimination of a noise signal that has been superimposed on the underlying video. In contrast, applicants describe a technique for identifying that the underlying video itself contains both a random noise portion and a normal video portion. The noise signal elimination approach of Flannaghan clearly relies on an inter-frame statistics analysis, which is distinct from the intra-frame statistics analysis approach recited by applicants.

The Examiner's remarks appear at paragraph 4 to mischaracterize applicants' recited invention. In applicants' invention, bits are conserved by adjusting encoding of a macroblock that falls within the random noise portion of the frame and then using those conserved bits for macroblocks that fall within the normal video portion. This is because a viewer's attention will naturally be directed to the normal video portion of the frame, since the remaining portion of the frame is random noise. This conserving of bits for the normal video portion is believed unique to the present invention. A careful reading of the applied art fails to uncover any suggestion or implication that bits should be conserved from, for example, a highly complex image area for use in a "normal video" portion which contains less complexity. Applicants' invention is believed counterintuitive in this aspect.

Additionally, as explained further below with reference to the dependent claims, how the activity calculation of a macroblock is performed is fundamentally different from that described by Uz. After noting that Uz does in fact describe an activity level calculation, the Examiner states "evidently, there is no fundamental difference between Uz's activity level calculation and applicants' activity level calculation because both pertain to activity level in macroblocks". This conclusion is patently a mistake. Simply because two approaches relate to achieving an activity level measurement does not mean that one approach teaches or suggests the other. Applicants disclose and recite in the present application a unique, non-obvious approach to determining activity level in macroblocks, as explained further below in connection with the dependent claims.

For all the above reasons, applicants respectfully request reconsideration of the obviousness rejection to the claimed subject matter based upon the teachings of Uz and Flannaghan.

The dependent claims are believed allowable for the same reasons as the independent claims from which they depend, as well as for their own initial characterizations.

With reference to claim 7, applicants note that the independent claims presented herewith each expressly recite that a macroblock within a random noise portion is biased predictive coded when the macroblock exceeds the predefined threshold. A careful reading of column 11, lines 20-26 of

Uz fails to uncover any teaching, suggestion or implication of such a concept.

In claim 9, applicants recite that the adjusting encoding (iii) includes determining an adjusted quantization level for use in encoding the macroblock. This adjusted quantization level is determined to conserve bits used in encoding the macroblock when the macroblock activity level exceeds the predefined threshold. In comparison, Uz discloses a scheme to adjust the quantization step size (Col. 12, line 50-53) based on the bits used. This calculation is referred to in the present application as CAL QL. In claim 9, the CAL QL is adjusted further in order to conserve bits because the macroblock has been found to be a noisy macroblock in a noisy portion of the frame. The adjusted quantization step size is referred to in the present application as ADJ QL.

In claims 12 & 13 applicants recite that the determining whether a random noise portion exists within a frame includes calculating a frame complexity value and comparing the frame complexity value to a predefined complexity threshold. In claim 13, the frame complexity value is defined as an accumulated absolute difference value (PIX DIFF) derived from adjacent pixels of the plurality of pixels in the frame. In comparison, the complexity measure in Uz is very different from that recite by applicants. Uz's complexity measurement is calculated after encoding the data. In contrast, applicants' claims 12 & 13 are based on unencoded input picture pixels and complexity is calculated before encoding the frame.

In claim 26, applicants recite a system for determining a macroblock activity level wherein the macroblock comprises multiple blocks. The system includes means for determining an activity level for each block of the macroblock, and means for ordering activity levels of the blocks and comparing the minimum activity level with the next to minimum activity level to derive an activity level for the macroblock.

In rejecting this claim, the Office Action acknowledges that Uz does not teach the determination of an activity level, and then states: "However, Uz fails to disclose the comparison of a minimum activity level of said order with a next minimum activity level of said order to derive said activity level for said macroblock as disclosed by the applicant. Therefore, it would have been obvious to one of ordinary skill in the art to compare the minimum activity level of said order with a next minimum activity level of said order to derive said activity level for said macroblock for encoding accuracy and efficiency." Applicants respectfully submit that a prima facie case of obviousness has not been stated against claim 26 based upon this language.

Specifically, Uz computes its values by using the minimum values from the blocks within the macroblock as well as those surrounding the macroblock. Col. 9, lines 12-21. Therefore, Uz always uses the minimum value calculated from blocks within and surrounding the macroblock as the value for the macroblock. In contrast, the current invention prioritizes the block values of those blocks contained within the macroblock from minimum to maximum. The invention then derives the macroblock activity level by

comparing the minimum and next to minimum values. As much as Uz can be applied to the current invention, Uz teaches away from both the use of information exclusively within the macroblock, as well as the use of a value other than the minimum as an activity level for the macroblock.

Obtaining the minimum value as taught by Uz does not require the ordering of values as recited by applicants. Applicants respectfully submit that the ordering of all block values is not disclosed, taught or suggested by Uz's use of the minimum value in calculating macroblock values.

In view of the above, allowance of all claims presented herein is respectfully requested. If, however, any issue remains unresolved, the examiner is invited to telephone applicants' undersigned representative to further discuss the application.

Respectfully submitted,

Kevin P. Radigan

Kevin P. Radigan, Esq.
Attorney for Applicants
Registration No. 31,789

Dated: May 21, 2002

HESLIN ROTHENBERG FARLEY & MESITI P.C.
5 Columbia Circle
Albany, New York 12203
Telephone: (518) 452-5600
Facsimile: (518) 452-5579